tions of all the facts will be difficult, perhaps impossible, to reach. At present, indeed, the facts which call for explanation are still in most cases but poorly determined, and the processes at work are insufficiently understood. Climate is not absolutely a constant. The pendulum swings to the right and to the left. And its swing is as far to the right as to the left. Each generation lives thru a part of one or two or even three oscillations. A snap-shot view of these oscillations makes them seem permanent. As Supan has well said, it was formerly believed that climate changes locally, but progressively and permanently. It is now believed that oscillations of climate are limited in time, but occur over wide areas. Finally, it is clear that man, whether by reforestation or deforestation, by flooding a desert or by draining a swamp, can produce no important or extended modifications of natural climate, which is governed by factors beyond human control.

CLIMATOLOGICAL DATA FOR VIRGINIA.

Mr. Edward A. Evans, Section Director of the Climatological Service in Virginia, has published in the annual report of that section for the year 1905 a short index to the special articles which have been printed in the reports of that section, from the first issue in July, 1891, to the end of the year 1905. About forty titles are mentioned in the list; among them are the following:

Title.	Date of report.
Heated periods	July, August, 1900.
Hydrographs of James River at Richmond, Va	Annual, 1898–1905.
James River freshets	Annual, 1901.
Long-record meteorological data at various stations	January, 1904–Febru'y, 1905.
(Similar synopses are included in all issues to date of the year 1906.)	
Notes on James River freshet of April 21–22, 1901	April, 1901.
Notes on freshets in James River during 1902	Annual, 1902.
Precipitation, heavy, remarks on	June, August, 1901.
Report on thunderstorm at Lincoln, Va	June, 1903.
Table of James River freshets, 1893–1896	Annual, 1900.
Table of flood rises in James River, 1870 to 1892	Annual, 1900.

A list and accompanying map [not reproduced] are also given showing every station in Virginia at which meteorological observations are known to have been taken in the past, but are not now taken. This supplements the regular list and map which show only the stations now reporting to the section center. The list of almost a hundred discontinued stations gives the years which their records cover, and states whether the records comprise temperature or precipitation, or both.

The oldest record mentioned is the temperature record at Bellona Arsenal, Chesterfield County, for the years 1824 to 1833. This, unfortunately, like most others, is incomplete even for the years mentioned. The record at Fort Monroe is next in age, and is the longest record of all (1825 to 1874, for temperature, while the precipitation record is from 1836 to 1890); but again the record is incomplete. Other places with records extending over periods of fifteen years, or more, are Accotink, Birdsnest, Christiansburg, Falls Church, Goshen, Lewinsville, Mount Solon, Powhatan Hill, Smithfield, and Snowville.

Beginning with January, 1906, Mr. Evans has been printing each month in the section report a climatological summary of all data for stations having sufficient record to sum up in this way, together with a little text covering the general character of the record, names, and period of incumbency of observers, location and exposure of instruments, etc. This he finds useful in stimulating the interest of observers in keeping up their records.

LAND AND SEA WINDS.

Dr. Max. Kaiser, of Halle, Germany, has just published a memoir on "The Land and Sea Winds of the Baltic Coast of Germany". This appears as a dissertation for the attainment of the degree of doctor of philosophy, and has been prepared under the special stimulus of Professor Doctor Brückner at the university, and also by the cooperation of Professor Doctor Köppen and Professor Doctor Grossmann of the Deutsche Seewarte at Hamburg, to which place Doctor Kaiser repaired in order to obtain the necessary observational data. In the preface to the present memoir the author regrets that we have so few special studies of the land and sea breezes in the temperate zones. He mentions, with especial approval, the work of Prof. William M. Davis of Harvard on the sea breezes of New England. Apparently Doctor Kaiser does not know of the elaborate memoir of Francis E. Loomis, the son of Prof. Elias Loomis, on the winds of New Haven, nor of the memoirs on the winds of our coast by Mr. T. H. Davis in the MONTHLY WEATHER REVIEW, Volume XXX, pages 261 and 519, which have been followed by another paper in the September REVIEW. A great amount of material on this subject is also found in that monumental work, "The Winds of the Globe," by James H. Coffin, published by the Smithsonian Institution.

The studies of Doctor Kaiser relate to the years 1901–1905, and to anemograms registered at five stations on the German coast of the Baltic Sea, namely at Memel, Pillau, Neufahrwasser, Rugenwaldermunde, and Swinemunde. The coast line from the first to the last of these stations stretches from the east-northeast toward the west-southwest for about two hundred and fifty miles; it is a comparatively low and flat coast, like the country for a long distance to the southward and eastward. In connection with the observations of the wind the author has also studied the barometric gradient between the land and the water, using the daily barometric observations at the lightship off Adlergrund, which ship is about fifty miles from the coast and sixty miles north of the anemograph at Swinemunde. Much use was also made of the weather records kept on board many German ships traveling along this coast, and these enabled the author to get a clear idea of the conditions prevailing at the moment when the sea breeze began.

To give precision to our ideas Doctor Kaiser begins by stating that by land and sea breezes he understands only those that are caused by the differences in temperature between the land and the sea, and that change decidedly with the time of day. He has, therefore, with the help of the anemograms, selected those special days that show an appropriate change in the direction of the wind, and which the synoptic charts also show to have had small barometric gradients, feeble winds, and comparatively clear sky. On such days as these, which are the only ones that he studies for diurnal effects, the wind blows from the land in the early morning, but from the water between midday and the evening, and again from the land during the later evening. The beginning and the duration of the sea breeze is very variable; often it begins as early as 8 a. m., but often, also, as late as 2 p. m. The reason for this is to be found in peculiarities of temperature, of pressure, and of cloudiness, to which subject a large part of the memoir is devoted. On the average the duration of the sea breeze is longer during the summer months than during the rest of the year.

The velocity of the sea breeze, on the average, is from two to three meters per second. The maximum velocity occurs between 2 and 4 p. m., or near the time of the maximum temperature. The number of days on which the sea breeze, strictly so-called, occurs varies in any single month, for any single station, between 6 and 26 per cent of the number of days in the month; the following figures represent the average percentages of five years for the five stations along this part of the Baltic coast: April, 7; May, 13; June, 15; July, 19; August, 17; September, 14. The sea breeze does not occur in the remaining months from October to March, since during these months the sea is always warmer than the land, and there can therefore be no diurnal exchange of wind. In general the frequency of

the sea breeze along this coast is very much less than the 38 per cent given by Davis for the New England coast; but this is largely because in the present investigation Kaiser has used only the days that show a land wind early in the morning and late in the evening, with a sea breeze in the immediate afternoon. These are, therefore, days with both sea and land wind, whereas Davis has considered principally the occurrence of the sea breeze. The geographic distribution of the sea breeze in this region differs in some respects from that found by students in other localities. When we chart the sea breezes observed at all of Kaiser's stations, we find that the bay in which Pillau is located experiences its sea breeze much later than the rest of the coast, and the same is true to a less extent of the bays represented by Swinemunde and Labagienen. At Neufahrwasser the sea breeze begins two hours later than at the two other stations, owing to its being protected by a cape jutting out to the northward.

With regard to the veering and backing of the wind there is considerable irregularity. The veering with the sun occurs only occasionally on this coast. There are four ways in which the wind may change: (1) continuous turning toward the right; (2) turning toward the right, followed by a backward motion toward the left; (3) continuous turning toward the left (backing), and (4) turning toward the left, followed by a retrogression or turning back toward the right. An examination of all the changes of the wind at the five Baltic stations shows that the third method almost never occurs, but the other three methods occur in about equal proportions. The rate at which the wind changes direction has been computed by Doctor Kaiser as an hourly rate, and varies between 0° and 28° per hour for changes toward the right, and from 0° to 47° per hour for changes toward the left. The change of direction when the sea breeze sets in is comparatively large, but the hourly change when it has attained its maximum strength is small.

The difference of pressure at sea level between two stations when the sea breeze is blowing is quite appreciable, amounting to fully half a millimeter of the mercurial barometer in the gradient between Swinemunde and the lightship, a hundred kilometers or sixty miles distant to the north, but becoming zero at the time when the land breeze or sea breeze dies away. We believe that this is the first time that these barometric gradients have been determined; we have often called attention to the fact that the air is so mobile that direct pressure gradients which are inappreciable to ordinary meteorological observations will suffice to make a strong wind, and that the gradients ordinarily shown on the weather maps, which are largely perpendicular to the direction of the wind, are the result of the centrifugal force of the wind on the rotating earth. Such slight gradients as those that drive the air thru a pneumatic tube are ordinarily neglected in meteorology, but we see them exemplified in the present case, where the gradient of a half millimeter per hundred kilometers produces a land breeze, or a sea breeze, of six meters per second. The difference of temperature of the air over the land and the sea for two stations nearly corresponding to those just mentioned was 5.7° C. at its maximum, and as this occurs at the time when the difference of pressure is the greatest and the sea breeze is the strongest Doctor Kaiser considers it to be the cause of these latter.

With regard to the distance to which the sea breeze extends landward or seaward, or the boundary between the region of land breeze and sea breeze, the author makes use of observations on board numerous ships. He finds that in general it is certain that on the German Baltic the sea breeze begins between four and five nautical miles from the coast, and that in its turn the land wind stretches even farther seaward; on the most favorable days the land wind may stretch eight nautical miles seaward. These figures relate to clear, cloudless sky. It seems impossible now to determine how far the sea breeze extends inward over the land, since the interior stations have no continuous records; but we may assume that the sea breeze penetrates comparatively far inland on account of the flatness of the country, and it may be as far as twenty or thirty kilometers, judging by comparison with the conditions on the New England coast.—*C. A.*

MONTHLY REVIEW OF THE PROGRESS OF CLIMATOLOGY THRUOUT THE WORLD.

By C. FITZHUGH TALMAN, U. S. Weather Bureau.

METEOROLOGICAL STATIONS IN ICELAND.

The accompanying chart, fig. 1, shows the distribution of the meteorological stations now in operation in Iceland. For the revision of this chart to October, 1906, the writer is indebted to the courtesy of Mr. L. V. S. Willaume-Jantzen, Subdirector of the Danish Meteorological Institute.

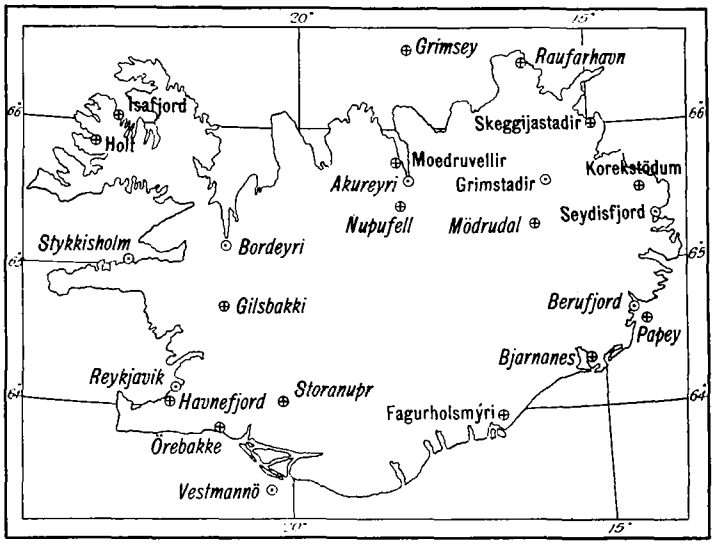

FIG. 1.—Meteorological stations in Iceland.

Elements observed: ⊕ Temperature. ⊙ Temperature and pressure. Many stations also observe wind, atmospheric humidity, and precipitation. Italics denote stations for which normals of any element have been published. (See text.)

The results of observations at the stations in Iceland are published annually in the second part of the Meteorologisk Aarbog of the Danish Meteorological Institute.

The stations whose names are italicized are those for which normals, of one element or more, have been published. The following are the principal collections of normals for Iceland:

Denmark. Danske meteorologiske Institut. Meteorologiske Middeltal og Extremer for Fåeroerne, Island og Gronland. (Appendix til det danske meteorologiske Instituts Aarbog 1895, II Del.). Kjobenhavn, 1899.

Willaume-Jantzen, V. Climat du littoral islandais. (Extr. Congrès maritime international de Copenhague, 1902.)

For Stykkisholm the best normals are those of J. Hann. See his important studies of the meteorology of Stykkisholm in Sitzungsberichte der mathematisch-naturwissenschaftlichen Klasse der kaiserlichen Akademie der Wissenschaften, Vienna, 113 Bd., Abt. IIa, 1904, pp. 183–269, and Meteorologische Zeitschrift, Jahrg. 22, 1905, pp. 354–357.

Normals for Reykjavik, the capital of Iceland, from a series of observations made 1823–1837, appear in the Zeitschrift der österreichischen Gesellschaft für Meteorologie, Bd. 6, 1871, p. 45. Normals from a later series appear in Buchan's "Report on Atmospheric Circulation".

Temperature normals for the following stations not shown on the accompanying chart are also given in Buchan's "Report